PROGRAM CHARTER
FOR
ECOSYSTEM RESEARCH PROGRAM
Program Manager: Leon M. Cammen
Ecosystem Goal Team Lead: Steve Murawski

1. EXECUTIVE SUMMARY

The National Oceanic and Atmospheric Administration (NOAA) Ecosystem Research Program (ERP) conducts applied research and development to provide the Ecosystem Goal Team and NOAA's stakeholders scientific information and tools for implementing and evaluating ecosystem management. The ERP's broad-based ecosystem research relies on both internal and extramural programs to focus on the natural and human related influences that affect ocean, coastal, and Great Lakes ecosystems. ERP research priorities are determined by legislative and executive mandates directing NOAA to manage specific ocean, coastal, and Great Lakes resources and ecosystems, to develop regional scientific infrastructure, and to support and conduct research that will help discover, manage, and conserve ocean, coastal, and Great Lakes resources for future generations. In addition to its research capabilities, ERP strengthens stewardship through outreach and education to enhance informed decision making by coastal communities, stakeholders, and users of ocean, coastal and Great Lakes resources, and facilitates the application of new research, technologies, and tools to promote responsible and sustainable use of those resources.

A combination of intramural and extramural programs provide ERP the flexibility to direct Program resources to meet annual and longer-term needs identified by the Ecosystem Goal Team and other stakeholders. This flexibility is vital to NOAA's ability to address emerging science issues. More information is available at the ERP website: http://www.oarhq.noaa.gov/erp/.

2. PROGRAM REQUIREMENTS

A. Requirement Drivers: The Ecosystem Research Program is governed by a series of statutes that require NOAA to provide coastal managers with scientific knowledge, financial assistance, and other support to manage the coastal zone to support society's needs. The following statutes, executive orders, and international agreements are the major Requirements Drivers for the ERP.

Summary of Major Requirements Drivers (Appendix A has complete list)

1. U.S. Ocean Action Plan
   - Support ecosystem-based approaches to management, which requires indicators of ecosystem health and socio-economic benefits to be monitored and assessed.
   - Support a Regional Partnership in the Gulf of Mexico.
   - Advance Ocean Stewardship through Implementation of Cooperative Conservation Executive Order.

- Develop an Ocean Research Priorities Plan and Implementation Strategy - The Implementation Strategy will identify how the various ocean science sectors (government, academic, industry, and other non-government entities) can and should be engaged, individually or through partnerships. These types of strategies would include cooperative research)
- Build a Global Earth Observation Network, Including Integrated Oceans Observation: Develop a strategy for integration and possible convergence of existing and future requisite coastal observing systems of the IOOS.
- Increase Ocean Education Coordination: Data collected through ocean ecosystem research programs and through NOAA Sea Grant partnerships are translated into usable forms for teachers, students, and the general public
- Support an Integrated Approach to Oceans Management and Reduction of Land-based Pollution
- Advance the Use of Large Marine Ecosystems

2. Magnuson Stevens Fishery Conservation and Management Act:
   - This is the primary law governing marine fisheries. It contains the primary legal mandate for this requirement, Section 404, which identifies the following areas of research.
   - "Research to support fishery conservation and management, including but not limited to, biological research concerning the abundance and life history parameters of stocks of fish, the interdependence of fisheries or stocks of fish, the identification of essential fish habitat, the impact of pollution on fish populations, the impact of wetland and estuarine degradation, and other factors affecting the abundance and availability of fish."
   - "Conservation engineering research, including the study of fish behavior and the development and testing of new gear technology and fishing techniques to minimize bycatch and any adverse effects on essential fish habitat and promote efficient harvest of target species."

3. National Sea Grant College Program Act*:*
   - The objective of the Sea Grant Act is "to increase the understanding, assessment, development, utilization, and conservation of the Nation's ocean, coastal, and Great Lakes resources by providing assistance to promote a strong educational base, responsive research and training activities, broad and prompt dissemination of knowledge and techniques, and multidisciplinary approaches to environmental problems."
   - The Act directs the Secretary of Commerce to " . . .provide support for . . . national strategic investments in fields relating to ocean, coastal, and Great Lakes resources..." The Act funds a national sea grant network with 30 Sea Grant state programs, which include fisheries extensions. The Sea Grant Act is explicit in requiring that each Sea Grant program maintain "a program of research … in fields related to ocean, coastal, and Great Lakes resources."

4. National Environmental Policy Act:

- The NEPA requires each federal agency to assess the impact of alternatives for their actions (including activities conducted, funded or permitted by the agency) on the human environment. The cumulative impacts of each activity in combination with

other natural and anthropogenic phenomena are included among the analyses.

5. Marine Mammal Protection Act:
- Protect marine mammals and their habitats to maintain sustainable populations as functional components of the ecosystems of which they are a part.
- Directs the Secretary of Commerce to undertake a scientific research program to monitor the health and stability of the Bering Sea marine ecosystem and to resolve uncertainties concerning the causes of population declines of marine mammals, sea birds, and other living resources of that marine ecosystem.

6. Endangered Species Act:
- The ESA requires the Secretary of Commerce (with responsibility delegated to NMFS) to evaluate the status of species (or lower taxons) and determine whether or not the species is threatened or endangered; to designate critical habitat; and to evaluate Federal actions and ensure that these actions do not jeopardize the continued existence of threatened or endangered species or adversely modify critical habitat. The information standard for the ESA is the best available scientific information.

7. Coastal Zone Management Act of 1972 ; Coastal Zone Act Reauthorization Amendments of 1990:
- The goal of the Coastal Zone Management Act (CZMA) is to encourage states to preserve, protect, develop and, where possible, restore and enhance valuable natural coastal resources.

8. National Marine Sanctuaries Act:
- NOAA shall support, promote, and coordinate scientific research on, and long-term monitoring of, the resources of these marine areas, and evaluate the implementation of each sanctuary's management plan and goals.
- Mandates NOAA to "prevent or eliminate damage to the environment and biosphere and stimulate the health and welfare of man."

9. Public Health and Welfare – Pollution Prevention and Control Act:
- "The Administrator [of the EPA], in cooperation with the Under Secretary of Commerce for Oceans and Atmosphere, shall conduct a program to identify and assess the extent of atmospheric deposition of hazardous air pollutants (and in the discretion of the Administrator, other air pollutants) to the Great Lakes, the Chesapeake Bay, Lake Champlain and coastal waters.

10. Harmful Algal Bloom and Hypoxia Research Control Act:
- The National Oceanic and Atmospheric Administration, through its ongoing research, education, grant, and coastal resource management programs, possesses a full range of capabilities necessary to support a near and long-term comprehensive effort to prevent, reduce, and control harmful algal blooms and hypoxia; ``(11) funding for the research and related programs of the National Oceanic and Atmospheric Administration will aid in improving the Nation's understanding and capabilities for addressing the human and environmental costs associated with harmful algal blooms and hypoxia; and…".

- NOAA shall develop research plans and assessments and examine alternatives to reduce, mitigate, and control hypoxia and harmful algal blooms *in coastal waters including the* Great Lakes.
- NOAA shall support a comprehensive effort to examine the causes and ecological and economic consequences of Harmful Algal Blooms (HABs) and hypoxia, and to describe the potential ecological and economic costs and benefits of policy and management actions to prevent, reduce, and control HABs and hypoxia.
- NOAA shall assess HABs and hypoxia not less than once every 5 years.

11. Oceans and Human Health Act:
- The Secretary of Commerce is required to establish an Oceans and Human Health Initiative to coordinate and implement research and activities of the National Oceanic and Atmospheric Administration related to the role of the oceans in human health.
- NOAA shall provide support for (1) program and research coordination; (2) an advisory panel; (3) one or more National Oceanic and Atmospheric Administration national centers of excellence; (4) research grants; and (5) distinguished scholars and traineeships.

12. National Aquatic Invasive Species Act:
- The Non-indigenous Aquatic Nuisance Prevention and Control Act of 1990 and the National Invasive Species Act (NISA) of 1996 (16 USC 4701+) give NOAA a leadership role in the planning, coordination, and execution of invasive species prevention, monitoring, and control actions, supported by research and outreach activities.

13. The Estuary (Estuarine) Protection Act:
- The Estuary (Estuarine) Protection Act is administered by the Department of the Interior and provides a means to protect, conserve, and restore estuaries in a manner that maintains balance between the need for natural resource protection and conservation and the need to develop estuarine areas to promote national growth. The Act requires the Secretary of the Interior to work with the states and other Federal agencies in undertaking studies and inventories of the Nation's estuaries. These studies and inventories shall include the assessment of the wildlife and recreation potential of estuaries, their ecology, their value to the marine, anadromous and shell fisheries, and their aesthetic value; their importance to navigation and flood control and their mineral value their value for more intensive economic development.

14. Charting the Course for Ocean Science in the United States for the Next Decade: An Ocean Research Priorities Plan and Implementation Strategy:
- The Ocean Research Priorities Plan describes national ocean research efforts that must be pursued over the next ten years. Developed with extensive ocean community involvement, this document represents the first national effort to identify research priorities that address key interactions between society and the ocean. This document will serve to guide research efforts for the ocean community, including the federal agencies, for the next decade.

B. Mission Requirements:

Appendix B shows the relationship between ERP Mission Requirements and the complete set of Requirements Drivers. Based on the requirement drivers identified in section 2A, ERP has identified a set of mission requirements. The major requirement drivers are listed after each of the Mission Requirements; the numbers refer to section 2A.

1. Explore and characterize ecosystem health: Explore and characterize ecosystem health, which includes identification of the physical location and extent as well as the biological, chemical, physical, and human characteristics of an ecosystem, to ensure sound management and assessment of coastal and ocean ecosystems. Acquire information on ecosystem productivity, function, and condition (1-6, 8-14).

2. Identify causes and consequences of changes in ecosystem condition: Identify causes and consequences of changes in ecosystem conditions to identify ecosystem stressors and determine the processes by which they act in order to provide resource managers with the information required to balance environmental, social, and economic goals (1-11, 13-14).

3. Develop forecasts to predict ecological *(and socioeconomic)* impacts: Develop ecosystem status and health forecasts to predict ecological *(and socioeconomic)* impacts and provide coastal and ocean managers better insight in to the effects of their decisions in the context of societal needs and goals (1-11, 14).

4. Develop technologies and tools: Develop technologies and tools required to increase our understanding of ocean, coastal, and Great Lakes ecosystems, facilitate the ecosystem approach to management, and promote responsible and sustainable use of ocean, coastal, and Great Lakes resources (1-3, 5-11, 14).

5. Strengthen stewardship through outreach and education: Strengthen stewardship through outreach and education to enhance informed decision making by coastal communities, stakeholders, and users of ocean, coastal and Great Lakes resources, as well as to facilitate the application of new research, technologies, and tools (1-3, 5-7, 10-11, 14).

3. LINKS TO THE NOAA STRATEGIC PLAN

The ERP's contribution is critical in supporting NOAA's mission "To understand and predict changes in Earth's environment and conserve and manage ocean, coastal and Great Lakes resources to meet our Nation's economic, social, and environmental needs." The ERP provides the understanding of ocean, coastal, and Great Lakes ecosystems and the resources they include to inform decision-makers, to promote responsible and sustainable use of those resources, and to encourage environmental stewardship.

A. **Goal Outcomes:** The ERP contributes to the Ecosystem Goal Outcomes in the following ways:

- *Healthy and productive coastal and marine ecosystems that benefit society.* The ERP focuses broad-based ecosystem research on natural and anthropogenic factors that affect ocean, coastal, and Great Lakes ecosystems, specifically addressing protected species conservation, human health issues relating to the ocean, environmental and economic health of coastal communities, and habitat conservation and restoration. ERP characterizes ecosystems, identifies the stressors affecting ecosystem condition, and determines the processes by which they act. The ERP uses that information to develop models to support an expanding suite of integrated ecosystem status and health forecasts that provide coastal decision-makers better insight into the consequences of their actions in the context of societal needs and desires. The ERP also develops the technologies and tools required to increase our understanding of ocean, coastal, and Great Lakes ecosystems, to facilitate the ecosystem-approach to management, and to promote responsible and sustainable use of ocean, coastal, and Great Lakes resources.

- *A well informed public that acts as a steward of coastal and marine ecosystems.* The ERP enhances informed decision-making through knowledge transfer and strives to have citizens, educators, resource managers, community leaders and industry routinely use and benefit from ERP products and services. This capability also facilitates the transition to application of new research, technologies, and tools. This capability includes engagement with coastal communities, stakeholders, and users regarding ocean, coastal, and Great Lakes issues.

B. **Goal Performance Objectives:** The ERP contributes to the Ecosystem Goal Performance Objectives in the following ways:

- *Increase number of regional coastal and marine ecosystems delineated with approved indicators of ecological health and socioeconomic benefits that are monitored and understood:* As described above, the ERP characterizes ecosystems and identifies the processes determining ecosystem condition.

- *Increase number of fish stocks managed at sustainable levels; Increase number of protected species that reach stable or increasing population levels; Increase number of invasive species populations eradicated, contained, or mitigated; Increase number of habitat acres conserved or restored:* As described above, the ERP conducts research and develops forecasts of living ocean, coastal, and Great Lakes resources and their habitats, including environmental, economic and sociocultural assessments, to inform ocean, coastal, and Great Lakes resource managers.

- *Increase environmentally sound aquaculture production:* The ERP carries out research, technology development and technology transfer to promote responsible and sustainable use of ocean, coastal, and Great Lakes resources.

- *Increase portion of population that is knowledgeable of and acting as stewards for coastal and marine ecosystem; Increase number of coastal communities incorporating ecosystem and sustainable development principles into planning and management:* As described under Ecosystem Goal Outcome #2, the ERP enhances coastal stewardship and informed decision-making through knowledge transfer.

C. Goal Strategies:

ERP implements the following strategies to achieve its goal outcomes:

- Engage and collaborate with our partners to achieve regional objectives by delineating regional ecosystems, promoting partnerships at the ecosystem level, and implementing cooperative strategies to improve regional ecosystem health.
- Characterize ocean, coastal and Great Lakes ecosystems and explore unknown and poorly-known areas of the world ocean.
- Manage uses of ecosystems by applying scientifically sound observations, assessments, and research findings to ensure the sustainable use of resources and to balance competing uses of ocean, coastal and Great Lakes ecosystems.
- Improve resource management by advancing our understanding of ecosystems through better simulation and predictive models. Build and advance the capabilities of an ecological component of the NOAA global environmental observing system to monitor, assess, and predict national and regional ecosystem health, as well as to gather information consistent with established social and economic indicators.
- Develop coordinated regional and national outreach and education efforts to improve public understanding and involvement in stewardship of ocean, coastal and Great Lakes ecosystems.
- Engage in technological and scientific exchange with our domestic and international partners to protect, restore, and manage ocean, coastal, and Great Lakes resources within and beyond the Nation's borders.

4. PROGRAM OUTCOMES

ERP outcomes reflect the program mission and are based on the NOAA 20-Year Research Vision and 5-Year Research Plans:

1. Resource managers use the best available science to make ecosystem-based decisions.
2. A well informed public able to make informed decisions that best respect the ecosystem while allowing for economic benefits and enjoyment.
3. Human health risks decrease as a result of improvements in the condition of ocean, coastal, and Great Lakes resources.
4. Resource managers and society benefit from the development, demonstration, and transfer of technology that ensures sustainable use of ocean, coastal, and Great Lakes resources.

By providing the scientific foundation to an ecosystem approach to management of coastal and ocean resources, the ERP will enable complex societal choices to be informed by comprehensive and reliable scientific information. Ecosystem research will enhance understanding of physical/chemical/biological interactions and the ability to link ecosystem capacity and models to environmental variability and change. Understanding of multi-species relationships will be advanced, and eventually fully coupled with environmental variability and change. Ocean exploration will increasingly characterize the unknown physical, chemical, biological, and geological aspects of our seas, providing new hypotheses in ecosystem and climate research. Technologies to support advanced

research and the sustainable use of new ocean, coastal, and Great Lakes resources will be developed and tested to ensure that NOAA remains on the frontier of our understanding of ocean processes and resources.

Building on this information, ERP will develop forecasts for a suite of ecological conditions including fisheries, anoxia, harmful algal blooms, beach closings, and water quality. Once developed, these ecological forecasts will be operationally produced by the Ecosystem Observing and other NOAA programs. ERP research will result in a sound scientific basis for an array of ecosystem indicators with known meaning, an observing system to measure indicators, and models that evaluate tradeoffs between multiple sources of ecosystem stress and type of societal costs and benefits. Improved science-based information will allow us to better manage problems such as variable seafood production, harmful algal blooms, coral reef bleaching events, and ecosystem deterioration by alien and invasive species.

5. PROGRAM ROLES AND RESPONSIBILITIES

This program is established and managed with the procedures established in the NOAA Business Operations Manual (BOM). Responsibilities of the Program Manager are described in the BOM. Responsibilities of other major participants are summarized below.

A. Participating Line Office, Staff Office, and Council Responsibilities:

The ERP Board of Directors is made up of a senior representative from each of the line offices participating in the ERP and is chaired by the Program Manager who has 51% of the vote concerning all programmatic decisions. The Board provides program oversight and guidance, sets policy, and connects Goal Team and Line Office planning and implementation.

- Program Manager – Leon Cammen
- NOAA Fisheries: Philip Hoffman
- NOAA Oceans & Coasts: Gary Matlock
- NOAA Research: Barbara Moore

1. NOAA Fisheries (NMFS) is responsible for the coordination, administration, and execution of the protected species components of the Ecosystem Research program. This includes budget allocation and execution, tracking of milestones, and completion of protected species research activities. NMFS is also responsible for maintaining collaborative linkages to other Federal and state agencies, stakeholders, and the public.

2. NOAA Ocean Service (NOS) is responsible for characterizing ecosystem health, identifying the causes and impacts of changes in ecosystem condition, and developing and transferring tools and technologies, including ecological forecasts, that improve ecosystem based management. The NOS conducts and supports research across U.S. oceans, coasts, and Great Lakes, but concentrates its efforts on NOAA protected areas. These include coastal estuaries and estuarine research reserves, National Marine Sanctuaries, coral reef ecosystems, and coastal oceans.

3. NOAA Research (OAR) is responsible for ecosystem exploration and characterization, for identifying causes and impacts of changes in ecosystem condition, developing and transferring tools and technologies, including ecological forecasts that improve ecosystem based management, and for promoting the development and sustainable use of ocean, coastal, and Great Lakes resources. OAR also has outreach and education responsibilities to inform coastal decision-makers and resource managers to promote the sustainable use of ocean, coastal, and Great Lakes resources.

4. NOAA Research Council provides corporate oversight and develops policy to ensure that NOAA research activities are of the highest scientific quality, meet long-range societal needs, take advantage of emerging scientific and technological opportunities, shape a forward-looking research agenda, and are accomplished in an efficient and cost effective manner. The Research Council is responsible for ensuring that all NOAA services are based on sound science and that all NOAA research programs and long term plans are consistent with the NOAA Mission, NOAA Strategic Plan and recommendations contained in National Research Council and NOAA Science Advisory Board (SAB) research reviews.

5. NOAA Oceans Council is responsible for coordinating ocean activities across NOAA; proposing priorities and investment strategies for ocean-related initiatives; identifying ocean and coastal programs that might benefit most from integration; and coordinating NOAA's participation in the interagency National Oceanographic Partnership Program (NOPP). The NOC is also authorized to develop a strategy and serve as the agency focal point for responding to and implementing the recommendations of the U.S. Commission on Ocean Policy. The Ocean Council proposes priorities and investment strategies for ocean-related initiatives to the ERP and helps identify ocean and coastal programs that might benefit most from integration.

6. NOAA Observing Council is responsible for coordinating observational and data management activities across NOAA; proposing priorities and investment strategies for observation related initiatives; and identifying programs that might benefit most from integration.

7. NOAA Safety Council supports the effective implementation of the NOAA Safety Program and NOAA Safety Policy. It is responsible for reviewing and approving the annual safety action plans and performance measures of ERP's component programs to ensure that these support the NOAA safety program.

8. NOAA General Counsel is responsible for approving grants and interagency agreements.

9. NOAA Education Council is responsible for developing cross-cutting priority goals and projects related to environmental literacy, outreach and education. One major component of ERP's efforts and coordination with the NOAA Education Council is the NOAA Sea Grant Network which offers a variety of programs and resources in marine and aquatic sciences for K-12 students and teachers, undergraduate and graduate students and the general public

10. NOAA Marine and Aviation Operations (NMAO) is responsible for providing ship and aircraft platforms for research and observing systems during field experiments.

11. Administrative Services is responsible for providing administrative support for grants.

12. NOAA Facilities is responsible for providing a safe and productive work environment. Facililities provides office space for ERP members as well as other support.

13. IT Services is responsible for providing the general IT services required by the program.

14. NOAA Platform Allocation Council provides guidance to ERP on future ship and aircraft allocation capabilities and policy..

B. External Agency/Organization Responsibilities

1. Environmental Protection Agency (EPA)**:** ERP and EPA's Offices of Wetlands, Oceans and Watersheds and Policy, Economics and Innovation work together to enhance community development and Smart Growth education and training opportunities to local decision-makers. ERP and EPA's Great Lakes National Program Office work cooperatively to improve understanding that leads to improved ecosystem management of the Great Lakes. ERP and the EPA STAR program collaborate on the competitive interagency Ecology and Oceanography of Harmful Algal Bloom Program (ECOHAB).

2. National Science Foundation (NSF): ERP and NSF increase collaboration and communications among ocean scientists, educators and the general public through the cooperatively run Centers for Ocean Science Education Excellence (COSEE). The seven COSEE centers facilitate the integration of research into high quality educational activities, programs and materials in order to engage students and their teachers, and develop their interest into a mature understanding of the relevance of the oceans to their lives. ERP and the NSF Division of Ocean Sciences collaborate on the competitive interagency Global Ocean Ecosystems Dynamics Program (GLOBEC).

3. Federal Task Forces**:** Task Force interaction facilitates coordination with Federal, State, tribal, academic, and industry partners and informs ERP problem identification, planning, and implementation. The ERP actively participates in the Coral Reef Task Force, Aquatic Nuisance Species Task Force, Gulf of Mexico Hypoxia Task Force, Great Lakes Interagency Task Force, and the South Florida Ecosystem Restoration Task Force. As part of the Comprehensive Everglades Restoration Program, NOAA (NOS, NMFS, and OAR) is managing the marine component of the largest ecosystem restoration project in U.S. history. Through ERP, NOAA is working with Federal, state, and local agencies to benchmark, monitor, and eventually predict changes in adjacent marine ecosystems resulting from terrestrial changes to water flow through the Florida Everglades.

4. National Aeronautics Space Administration (NASA)**:** ERP and NASA's Space Grant and USDA's Cooperative State Research Education and Extension Service share goals related to improved environmental decision-making, and cooperatively fund a geospatial

specialist to provide NASA geospatial information to coastal community development specialists. ERP and NASA also share goals in exploration and partner on the use of NOAA's underwater laboratory, *Aquarius* as a space station analog supporting astronaut training and development of technologies for remote applications in the sea and in space.

5. Universities and Colleges**:** ERP relies on partnerships with universities to augment NOAA's internal programs. The National Sea Grant Program, the National Undersea Research Program, the National Centers for Coastal Ocean Science, and OAR Research Laboratories' Cooperative Institutes provide long term institutional arrangements that support research as well as infrastructure and expertise to ensure that both federal and non-federal personnel have access to advanced underwater technologies and extension and outreach resources. The following examples illustrate the variety in ERP-university partnerships:

- The Sea Grant Law Center disseminates information about marine laws and policies, coordinates ocean and coastal law researchers, and provides the ERP and its constituents a source of critical analysis of marine laws and policies.
- ERP administers the NOAA Environmental Cooperative Science Center (ECSC) in collaboration with Florida A&M University, Delaware State University, Jackson State University, Morgan State University, South Carolina State University, and the University of Miami. ECSC was established in 2001 to (1) increase the number of underrepresented minorities in atmospheric, environmental, and oceanic sciences by training students and expanding the capacity of faculty from member institutions to participate in NOAA related research; (2) develop tools, including conceptual models, to assess the response of coastal ecosystems and communities to perturbation and develop measurement programs to monitor critical system attributes; (3) improve the scientific basis for coastal resource management; and (4) facilitate community education and outreach relating to the function and significance of coastal ecosystems.
- The three NOAA Ocean and Human Health Centers (in Seattle, WA; Charleston, SC; and Ann Arbor, MI) are built on partnerships with the federal, state, academic and nonprofit communities. For example, the Medical University of South Carolina and the University of Charleston are partners in the Hollings Marine Laboratory, a multi institutional, multi-disciplinary institution developing science and biotechnology applications to sustain, protect, and restore coastal ecosystems, emphasizing linkages between environmental and human health.
- Cooperative institutes leverage ERP personnel, funding, and equipment and broaden the Program's expertise through collaboration with research institutions. Cooperative institutes with a primary emphasis on ecosystem research include: Cooperative Institute for Limnology and Ecosystems Research (CILER) at the University of Michigan and Michigan State University, Cooperative Institute for Climate and Ocean Research (CICOR) at the Woods Hole Oceanographic Institution, Joint Institute for Marine Observations (JIMO) at the Scripps Institute of Oceanography and the University of California, San Diego, Joint Institute for the Study of the Atmosphere and Oceans (JISAO) at the University of Washington, Cooperative Institute for Marine Resources Studies (CIMRS) at Oregon State University, Joint Institute for Marine and Atmospheric Research (JIMAR) at the University of Hawaii and The Cooperative Institute for Marine and Atmospheric Studies (CIMAS) at the University of Miami.

- The University of Mississippi and University of Southern Mississippi are partners in NIUST (National Undersea Technology Institute), a multi-institutional, multi-disciplinary institute developing advanced technologies to support undersea research and biotechnologies using marine natural products.
- The NCCOS Center for Sponsored Coastal Ocean Research funds regional research efforts in partnership with the extramural research community to address high priority issues. These efforts are typically large-scale, long-term efforts involving multidisciplinary teams of scientists from several universities to develop predictive tools for ecosystem management.

6. END USERS OR BENEFICIARIES OF PROGRAM

ERP has two categories of user groups - those who use the end products of research, and those who are recipients of financial awards. ERP validates the effectiveness of its products and services with the end users through surveys, consultation, and external reviews.

1. NOAA**:** The ERP provides NOAA the scientific information and tools necessary to address its science and management mandates, including implementing and evaluating ecosystem management. It is the responsibility of the ERP to meet the research requirements of the Ecosystem Goal, and it is working with each of the Goal Team Programs (Coastal and Marine Resources Program, Coral Program, Fisheries Management Program, Ecosystem Observation Program, Aquaculture Program, Protected Species Management Program, Habitat Program, and Enforcement) to identify, address, and evaluate the Program's success in meeting those requirements.

2. Coastal Managers**:** The ERP provides timely, sound, and relevant science to support coastal management decisions by managers in Federal (including NOAA), state, tribal, and international governments and agencies. For example, ERP characterizations have informed protected area boundaries and sea grass damage recovery models that are routinely used to set reparations in ship grounding cases.

3. Stakeholders**:** Stakeholders include environmental groups, recreational and commercial industry groups, and the public with an interest in what ERP does and how ERP decides which research to conduct. Segments of these groups routinely use ERP products and services to inform ocean and coastal management decisions and to assess the impacts and effectiveness of those decisions. In addition, the education community and the public benefit from ERP outreach and education activities and products.

4. Research Community**:** Once operational, the ecosystem characterizations, models, and forecasts developed by ERP are used by the research community to design and implement monitoring and research programs. For example, harmful algal bloom and hypoxia forecasts are used to redirect water quality monitoring.

APPENDIX A: REQUIREMENTS DRIVERS

The Ecosystem Research Program is governed by a series of statutes, executive orders, and international agreements defining the national oceans policy. The statutes require NOAA to provide coastal managers with scientific knowledge, financial assistance, and other support to manage the coastal zone to support society's needs. This Appendix lists those statutes and mandates.

National Environmental Policy Act (42 USC 4321 et seq.)

- The NEPA requires each federal agency to assess the impact of alternatives for their actions (including activities conducted, funded or permitted by the agency) on the human environment. The cumulative impacts of each activity in combination with other natural and anthropogenic phenomena are included among the analyses.
- Directs NOAA to "prevent or eliminate damage to the environment and biosphere and stimulate the health and welfare of man."
- Requires NOAA to "enrich the understanding of the ecological systems and natural resources important to the Nation."

National Coastal Monitoring Act, Title V of the Marine Protection, Research, and Sanctuaries Act, (33 U.S.C. 2801-2805):

- Requires NOAA and EPA to develop and implement a program for the long-term collection, assimilation, and analysis of scientific data designed to measure the environmental quality of the nation's coastal ecosystems.
- NOAA and the EPA shall jointly to submit to Congress a report, every other year, on the condition of the nation's coastal ecosystems.

National Marine Sanctuaries Act (16 U.S.C. § 1431)

- NOAA shall support, promote, and coordinate scientific research on, and long-term monitoring of, the resources of these marine areas, and evaluate the implementation of each sanctuary's management plan and goals.
- Mandates NOAA to "prevent or eliminate damage to the environment and biosphere and stimulate the health and welfare of man."

National Sea Grant College Program Act

- Directs NOAA to support "national strategic investments in fields relating to ocean, coastal, and Great Lakes resources."
- Funds a national network of 30 Sea Grant state programs, each of which is required to maintain "a program of research … in fields related to ocean, coastal, and Great Lakes resources."

Outer Continental Shelf Lands Act of 1978 (43 U.S.C. §1347)

- The Secretary of Commerce shall conduct studies of underwater diving techniques and equipment, and improvement in diver performance. NOAA's Undersea Research Program and the NOAA Diving Program maintain this activity on behalf of the Secretary.

Harmful Algal Bloom and Hypoxia Research Control Act (16 U.S.C. § 1451):

- NOAA shall develop research plans and assessments and examine alternatives to reduce, mitigate, and control hypoxia and harmful algal blooms *in coastal waters including the* Great Lakes.

- NOAA shall support a comprehensive effort to examine the causes and ecological and economic consequences of Harmful Algal Blooms (HABs) and hypoxia, and to describe the potential ecological and economic costs and benefits of policy and management actions to prevent, reduce, and control HABs and hypoxia.
- NOAA shall assess HABs and hypoxia not less than once every 5 years.

Oceans and Human Health Act:

- The Secretary of Commerce is required to establish an Oceans and Human Health Initiative to coordinate and implement research and activities of the National Oceanic and Atmospheric Administration related to the role of the oceans in human health.
- NOAA shall provide support for (1) program and research coordination; (2) an advisory panel; (3) one or more National Oceanic and Atmospheric Administration national centers of excellence; (4) research grants; and (5) distinguished scholars and traineeships.

Magnuson-Stevens Fishery Conservation and Management Act:

- NOAA must eliminate over-fishing and balance social, economic, and environmental needs using the best available science.

Endangered Species Act:

- NOAA shall manage to prevent the extinction of endangered and threatened marine species. This requires research into the life history, habitat requirements, and threats to these species.

Marine Mammal Protection Act:

- NOAA shall to protect all marine mammal species and their habitats. This requires conducting research to clarify threats to and needs of the species and habitats.

Coral Reef Conservation Act (16 U.S.C. §§ 6401-6409):

- NOAA should map, monitor, assess, restore, and conduct scientific research of coral reefs.

Coastal Zone Management Act and Coastal Zone Act Reauthorization Amendments of 1990:

- NOAA must to encourage states to preserve, protect, develop and, where possible, restore and enhance valuable natural coastal resources. Accurate and sufficient ecosystem research is necessary to advance this effort.

The President's Oceans Action Plan:

- NOAA should use the "best science and data to inform our decision-making" in order to "advance the next generation of ocean, coastal and Great Lakes policy."

US Commission on Ocean Policy Report Recommendations 25-2 to 25-4:

- NOAA should move toward an ecosystem-based management approach.
- NOAA should produce cutting edge ocean data and science translated into high-quality information for managers.
- NOAA should promote lifelong ocean-related education to create well-informed citizens with a strong stewardship ethic.
- NOAA should develop a coordinated national research effort to better understand the links between the oceans and human health.

Coast and Geodetic Survey Act of 1947 (33 USC § 883a-i):

- NOAA shall conduct and sponsor applied research to improve surveying and cartographic methods, instruments, and equipments and assure the future availability and usefulness of ocean satellite data to the maritime community.

- NOAA shall conduct investigations and research in geophysical sciences.

Ocean Dumping Act, Title II of the MPRSA, (33 U.S.C. § 1401-1445):

- NOAA shall to initiate and conduct a comprehensive and continuing program of research with respect to the possible long-range effects of pollution, as well as monitoring programs to assess the health of the marine environment.

National Contaminated Sediment Assessment and Management Act (33 U.S.C. § 1271):

- NOAA, with the EPA and Department of the Army, shall conduct a comprehensive and continuing program to assess aquatic sediment quality, including the extent of pollutants in sediments and areas where pollutants in sediment pose a threat to fisheries resources and marine habitats.

Water Pollution Prevention and Control Act (33 USC§ 1268):

- NOAA shall conduct, through the *Great Lakes Environmental Research Laboratory*, the National Sea Grant College program, other Federal laboratories, and the private sector, appropriate research and monitoring activities which address priority issues and current needs relating to the Great Lakes.
- NOAA shall identify issues relating to the Great Lakes resources on which research is needed. The Research Office (Ecosystem Research Program) shall submit a report to Congress on such issues before the end of each fiscal year which shall identify any changes in the Great Lakes system with respect to such issues.
- NOAA and other parties to the Great Lakes Water Quality Agreement of 1978 – Amended 1987, should determine the mass transfer of pollutants between the Great Lakes basin ecosystem components and the processes controlling the transfer of pollutants; develop load reduction models for pollutants; determine cause-effect inter-relationships of productivity and ecotoxicity; determine the impact of water quality and the introduction of non-native species on fish and wildlife population and habitats; and develop approaches to population-based studies to determine the long-term, low-level effects of toxic substances on human health.

Regional Marine Research Program Act (16 USC §1447B):

- NOAA should establish regional research programs to set priorities for regional marine and coastal research in support of efforts to safeguard the water quality and ecosystem health of each region.
- NOAA shall carry out research through grants and improved coordination.

Commerce and Trade Act (15 USC §1511 sec 2901):

- The Secretary of Commerce is responsible for the conception, planning, and conduct of basic research and development in the fields of water motion, water characteristics, water quantity, and ice and snow.
- NOAA shall publish data and the results of research projects in forms useful to the Corps of Engineers and the public.
- NOAA shall operate a Regional Data Center for the collection, coordination, analysis, and the furnishing to interested agencies of data relating to water resources of the Great Lakes.

Executive Order 13113 Invasive Species:

- NOAA shall detect and respond rapidly to control populations of invasive species, conduct research on invasive species, and develop technologies to prevent introduction and provide environmentally sound control of invasive species.

Aquatic Nuisance Species (16 USC § 4741):

- As a Task Force Member, NOAA shall conduct research concerning possible methods for the prevention, monitoring and control of aquatic nuisance species.

National Aquatic Invasive Species Act of 2003 (sec 301, 401):

- NOAA, as part of the National Invasive Species Council, is responsible for developing a set of sampling protocols, a geographic plan, and a budget to support a national system of ecological surveys for rapid detection of aquatic invasive species.

Study of Migratory Game Fish, Waters, Research Purpose (16 U.S.C. § 760e):

- NOAA shall undertake a comprehensive continuing study of migratory marine fish of interest to recreational fishermen of the United States, including fish which migrate through or spend part of their lives in the inshore waters of the United States. The study shall include, but not be limited to, research on migrations, identity of stocks, growth rates, mortality rates, variation in survival, environmental influences, both natural and artificial, including pollution and effects of fishing on the species for the purpose of developing wise conservation policies and constructive management activities.

Public Health and Welfare – Pollution Prevention and Control (42 U.S.C. § 7412):

- NOAA shall conduct a program to identify and assess the extent of atmospheric deposition of hazardous air pollutants to the Great Lakes, the Chesapeake Bay, Lake Champlain and coastal waters.
- NOAA shall monitor, investigate the sources and deposition rates of atmospheric deposition of air pollutants (and their atmospheric transformation precursors), and conduct research to develop and improve monitoring methods and to determine the relative contribution of atmospheric pollutants to total pollution loadings to the Great Lakes, the Chesapeake Bay, Lake Champlain, and coastal waters.

Clean Air Act Amendments of 1990 (Title III):

- NOAA shall identify and assess the extent of atmospheric deposition of air pollutants to the Great Lakes, the Chesapeake Bay, Lake Champlain and coastal waters. Specifically, NOAA shall: 1) monitor; 2) investigate the sources and deposition rates of atmospheric deposition of air pollutants; 3) develop and improve monitoring methods and determine the relative contribution of atmospheric pollutants to total pollution loadings; 4) evaluate adverse effects to public health or the environment caused by deposition and assess the contribution of deposition to violations of water quality standards; and 5) sample for pollutants in biota, fish, and wildlife of the Great Lakes, the Chesapeake Bay, Lake Champlain and coastal waters and characterize the sources of such pollutants.
- NOAA shall biennially submit to the Congress a report on the results of the above monitoring, studies, and investigations, and a description of any revisions of the requirements, standards, and limitations pursuant to this Act and other applicable Federal laws as are necessary to assure protection of human health and the environment.
- NOAA shall determine whether the provisions of the Clean Air Act Amendment of 1990 are adequate to prevent serious adverse effects to public health and serious or widespread environmental effects.

Clean Air Act Amendments of 1990 (Title IX):

- NOAA shall improve understanding of the short-term and long-term causes, effects, and trends of ecosystems damage from air pollutants on ecosystems, by: 1) identifying regionally representative and critical ecosystems for research; 2)

evaluating risks to ecosystems exposed to air pollutants; 3) developing improved atmospheric dispersion models and monitoring systems; 4) evaluating the effects of air pollution on water quality, forests, materials, crops, biological diversity, soils, and other terrestrial and aquatic systems exposed to air pollutants; and 6) Estimation of the associated economic costs of ecological damage which have occurred as a result of exposure to air pollutants.

National Materials and Minerals Policy Research and Development Act (30USC 1601 et seq):

- NOAA shall conduct fundamental ocean research and discovery focused on gaining an understanding of the impacts of hydrothermal vents on virtually all major components of the global ocean environment.
- NOAA shall maintain ongoing in situ biological, physical, and chemical time-series observations in and around representative active submarine volcanic and hydrothermal regions, coupled with remote monitoring using acoustic technology.

Coastal Ocean Program, § 201(c) of Public Law 102-56:

- Authorizes a Coastal Ocean Program and directs NOAA to augment and integrate NOAA existing programs and include efforts to improve predictions of fish stocks, to better conserve and manage living marine resources.

Coastal Wetlands Planning, Protection, and Restoration Act:

- NOAA shall conduct and support coastal wetlands restoration and conservation projects, with particular emphasis on the state of Louisiana. This includes conducting research into the function of wetlands and efficacy of restoration and conservation efforts.

Executive Order 13158 regarding Marine Protected Areas (2000):

- NOAA shall protect the significant natural and cultural resources within the marine environment for the benefit of present and future generations by strengthening and expanding the Nation's system of marine protected areas (MPAs).
- NOAA is required to develop a scientifically based, comprehensive national system of MPAs representing diverse U.S. marine ecosystems, and the Nation's natural and cultural resources.

Government Performance and Results Act:

- NOAA is required to develop and implement an accountability system based on performance measurement, including setting goals and objectives and measuring progress toward achieving them.
- The ecosystem site characterizations ERP conducts are used to establish baselines, assess ecosystem status and trends, and evaluate management effectiveness by measuring change in status.

Lacy Act Amendments of 1981:

- NOAA shall conduct marine forensic research to support its enforcement mission including best techniques to allow identification of stock, species or taxon from a variety of fresh, decomposed, cooked, or preserved tissues or specimens (marine forensics) for trade or impact of human activities management.

OMB Circular A-16 (Coordination of Geographic Information and Related Spatial Data Activities):

- NOAA is required to improve management decisions in the coastal environment by providing access to the long-term coastal data record to support monitoring, prediction, and analyses; to help in the formulation of public policy; to facilitate

ecosystem approach to management.
- NOAA shall create a unified long-term database of coastal and marine datasets.

Oil Pollution Act:
- NOAA shall assess ecological damages for the natural resources under their trusteeship.
- NOAA is required to develop and implement a plan for the restoration, rehabilitation, replacement, or acquisition of the equivalent of, the natural resources under their trusteeship based on sound scientific research.

Water Resources Development Acts of 1992, 2000:
- NOAA shall conduct a comprehensive national survey of data regarding aquatic sediment quality in the United States.
- Approval of the Comprehensive Everglades Restoration Plan (CERP) as a framework and guide to restore, preserve, and protect the south Florida ecosystem including adjacent coastal water

United Nations Fish Stocks Agreement:
- NOAA is responsible for managing species and habitats that cross jurisdictional boundaries through activities such as: strengthening scientific research capacity in the field of fisheries and promoting scientific research related to the conservation and management of straddling fish stocks and highly migratory fish stocks for the benefit of all.

Great Lakes Water Quality Agreement of 1978—Amended 1987:
- Commits the U.S. to restore and maintain the chemical, physical and biological integrity of the Great Lakes Basin Ecosystem.
- Establishes the Great Lakes Water Quality Board and the Great Lakes Science Advisory Board; NOAA participants in both boards.

NOAA Strategic Plan, FY 2005 – FY 2010 (46a):
- Directs NOAA to manage uses of ecosystems by applying scientifically sound observations, assessments, and research findings to ensure the sustainable use of resources and to balance competing uses of coastal and marine ecosystems.

Charting the Course for Ocean Science in the United States for the Next Decade: An Ocean Research Priorities Plan and Implementation Strategy:
- Describes national ocean research efforts that must be pursued over the next ten years. Developed with extensive ocean community involvement, this document represents the first national effort to identify research priorities that address key interactions between society and the ocean.

APPENDIX B: ERP REQUIREMENTS DRIVERS AND MISSION REQUIREMENTS

ERP Mission Requirements are based on the statues, executive orders, and mandates listed in the Requirement Drivers column. This table shows how the Program's drivers map to the requirements.

REQUIREMENT DRIVERS	MISSION REQUIREMENTS				
	Explore & Characterize	Identify Causes & Consequences	Develop Forecasts	Develop Technologies & Tools	Strength Stewardship
The President's Oceans Action Plan	X	X	X	X	X
Magnuson-Stevens Fishery Conservation and Management Act	X	X	X	X	
National Sea Grant College Program Act	X	X	X	X	X
National Environmental Policy Act (42 USC 4321 et seq.)	X	X	X		
Marine Mammal Protection Act	X	X	X	X	X
Endangered Species Act	X	X	X	X	X
Coastal Zone Management Act and Coastal Zone Act Reauthorization Amendments of 1990		X	X	X	X
National Marine Sanctuaries Act (16 U.S.C. § 1431)	X	X	X	X	
Public Health and Welfare – Pollution Prevention and Control (42 U.S.C. § 7412)	X	X	X	X	
Harmful Algal Bloom and Hypoxia Research Control Act (16 U.S.C. § 1451)	X	X	X	X	X
Oceans and Human Health Act	X	X	X	X	X
National Aquatic Invasive Species Act of 2003 (sec 301, 401)	X				

Estuary (Estuarine) Protection Act	X	X			
Aquatic Nuisance Species Program (16 USC §4722 sec d, f, 1c)	X	X		X	X
Clean Air Act Amendments of 1990 (Titles 3 and 9)	X	X	X	X	
Coast and Geodetic Survey Act of 1947 (33 USC § 883a-i)	X	X		X	X
Coastal Ocean Program, § 201(c) of Public Law 102-567		X	X		
Coastal Wetlands Planning, Protection, and Restoration Act				X	
Commerce and Trade Act (15 USC §1511 sec 2901)	X	X		X	X
Comprehensive Environmental Response, Compensation, and Liability Act		X	X	X	
Coral Reef Conservation Act (16 U.S.C. §§ 6401-6409):	X	X	X	X	X
Estuary Restoration Act	X	X	X	X	X
Executive Order 13113 Invasive Species	X	X	X	X	X
Executive Order 13158 regarding Marine Protected Areas (2000)	X	X	X		
Executive Order 13340, Great Lakes Task Force	X	X	X	X	
Great Lakes Water Quality Agreement of 1978—Amended 1987	X	X	X	X	X
Great Lakes Water Quality Agreement of 1978—Amended 1987	X	X	X	X	X
Government Performance and Results Act	X			X	
Lacey Act Amendments of 1981	X	X		X	
National Aquaculture Act (1980 and revised 1985)	X	X	X	X	X
National Coastal Monitoring Act, Title V of the Marine Protection, Research, and Sanctuaries Act, (33 U.S.C. 2801-2805)	X	X		X	X
National Contaminated Sediment Assessment and Management Act (33 U.S.C. § 1271)	X				
National Materials and Minerals Policy Research and Development Act (30USC 1601 et seq)	X	X		X	X
NOAA Strategic Plan, FY 2005 – FY 2010	X	X	X	X	X

Ocean Dumping Act, Title II of the MPRSA, (33 U.S.C. § 1401-1445)	X	X	X	X	
Ocean Research Priorities Plan	X	X	X	X	X
Oil Pollution Act	X	X	X	X	
OMB Circular A-16 (Coordination of Geographic Information and Related Spatial Data Activities)	X	X	X		
Regional Marine Research Program Act (16 USC §1447B)	X	X	X	X	
South Florida Ecosystem Restoration Task Force	X	X	X		
Study of Migratory Game Fish, Waters, Research Purpose (16 U.S.C. § 760e)	X	X	X		
United Nations Fish Stock Agreement	X	X			X
US Commission on Ocean Policy Report Recommendations 25-2 to 25-4	X	X	X	X	X
Water Pollution Prevention and Control Act (33 USC§ 1268)	X	X	X	X	X
Water Resources Development Act of 1992	X				